

II. REMARKS

A. Introductory Remarks

Reconsideration and allowance of this application is requested. Claims 3-10, 14, and 16-19, 21-33 are currently pending in this application. By this Amendment, claims 3, 8, 14, 19, and 27 have been amended and claims 2 and 20 cancelled. New dependent claims 28-33 have been added. The written description support for the recitation, "wherein the hydroxylamine derivative is substantially free of hydroxylamine" appearing in claims 14 and 27 can be found on paragraph [0146] of the published application, US 2004/0134873.

B. Substance of Telephonic Interview

Applicants thank Examiner Anita Alanko for courtesies extended during the telephonic interview and discussions held on August 10, 2007. The following is Applicant's statement of the substance of those discussions.

Applicant discussed with the Examiner the nature of the rejections over Tsai and Sun in the final Office Action mailed on April 20, 2007. In particular, Applicant argued that Tsai and Sun in combination did not teach a metal polishing rate of less than about 250 Å/min as recited in independent claims 14 and 27. The Examiner asserted that the metal polishing rate is expected based on the teaching of Tsai because Tsai teaches a substantially same composition. Applicants discussed amending the scope of the composition claims by deleting hydroxylamine from the list of a hydroxylamine derivative. The Examiner suggested Applicants provide further explanation in the remarks section to distinguish the chemical properties of hydroxylamine from hydroxylamine derivatives, *i.e.*, hydroxylamine nitrate and sulfate salts. No agreement was reached during this telephonic interview.

C. Rejection of Claims 2-10, 14, 16-27 Under 35 U.S.C. §112, Second Paragraph

The Office Action rejected claims 2-10, 14, 16-27 under 35 U.S.C. 112, second paragraph, as being indefinite. In light of the amendments made to independent claims 14 and 27, Applicants traverse this rejection for the following reasons.

Applicants have amended independent claims 14 and 27 by rearranging and placing the phrase, "wherein the removal rate of the metal layer is less than about 250 Å/min" next to the

limitations of the polishing rates of the barrier and dielectric layers. Amended claims 14 and 27 recite a substrate having a metal oxide layer surface, upon which metal oxide surface a barrier layer is disposed, upon which barrier layer a metal layer is disposed and chemically mechanically polishing the substrate. Further, claims 14 and 27 recite the corresponding rates of removal of each of the three layers of the substrate being polished. Accordingly, Applicants submit that claims 14 and 27 are definite as recited because the removal rates refer to each of the layers being removed from the substrate and that the same composition is used in the CMP process. Therefore Applicants respectfully request withdrawal of this rejection.

D. The Rejection of Claim 2-10 and 14, 16-27 Under 35 U.S.C. §103(a)

The Office Action rejected claims 2-10 and 14, 16-27 under 35 U.S.C. §103 as allegedly obvious over U.S. Patent 7,008,554 (“Tsai”) in view of U.S. 6,858,540 (“Sun”). In light of the amendments made to independent claims 14 and 27, Applicants traverse this rejection for the following reasons.

Tsai does not teach or suggest all limitations of the amended independent claims 14 and 27. In contrast to amended independent claims 14 and 27, Tsai fails to teach a hydroxylamine derivate that is substantially free of hydroxylamine. As stated in the Office Action, Tsai teaches that his composition comprises hydroxylamine as a reducing agent. *See*, Office Action, p. 3; and Tsai col. 6, lines 49-51. Additionally, Tsai does not teach a metal removal rate of less than about 250 Å/min as recited in independent claims 14 and 27. What Tsai teaches is the rate of removal of the barrier material and dielectric removal rates. *See*, Tsai, col. 8 lines 54-58. For these reasons the amended independent claims 14 and 27 are believed to be allowable over Tsai.

Sun also does not teach or suggest all the limitations of amended claims 14 and 27. Sun fails to teach a composition that is substantially free of hydroxylamine. Sun teaches that his composition includes hydroxylamine as a reducing agent. *See*, Sun col. 4 lines 47-49. Additionally, Sun neither discloses the removal rate of the metal oxide nor the removal rate of the metal layer as recited in amended claims 14 and 27.

Moreover, the combination of Tsai and Sun fails to teach or suggest each and every limitation of amended claims 14 and 27. As discussed above, both Tsai and Sun fail to teach a composition that is substantially free of hydroxylamine and both fail to teach the rate of metal

removal as recited in amended claims 14 and 27. Thus, the combination of Tsai and Sun does not render obvious the subject matter of amended independent claims 14 and 27. Accordingly, independent claims 14 and 27 as amended are believed to be allowable over Tsai and Sun.

Applicants address here the issues that were raised in the telephonic interview held on August 10, 2007 regarding the recitation hydroxylamine derivative in claims 14 and 27. The Examiner had requested Applicants to provide further scientific information to distinguish hydroxylamine from hydroxylamine derivative.¹ In this regard, first Applicants have amended independent claims 14 and 27 to exclude hydroxylamine as a hydroxylamine derivative from these claims. In light of the amendments to claims 14 and 27, Applicants submit that both Tsai and Sun fail to teach a hydroxylamine derivative wherein the hydroxylamine derivative is substantially free of hydroxylamine. Both Tsai and Sun teach hydroxylamine in their polishing composition but fail to teach a hydroxylamine derivative. Because the amended claims 14 and 27 recite hydroxylamine derivative wherein the hydroxylamine derivative is free of hydroxylamine, the polishing rates of the metal layer, barrier layer, and the metal oxide layer would not be expected to be the same based on Tsai's teachings. In fact, the polishing rates of the metal and the dielectric layer as recited in claims 14 and 27 are different. Accordingly, amended claims 14 and 27 and the dependent claims that depend therefrom are unobvious over Tsai or Sun.

Applicants submit that hydroxylamine derivative such as the nitrate and sulfate salts as recited in the dependent claims 28-33 are prepared by various methods in the literature. For, example, U.S. Patent 6,258,983 to Wagaman, (attached herewith in a supplemental IDS), teaches a method of producing hydroxylamine nitrate (HAN) by adding nitric acid to form the HAN salt. Also, U.S. patent 6,469,163, (attached herewith in a supplemental IDS), teaches a method of producing hydroxylamine sulfate using a catalytic method involving reacting ammonium nitrate, ammonia, and sulfur dioxide to produce hydroxylamine diammonium sulfate, which is hydrolyzed to form hydroxylamine sulfate. Thus, these methods of producing the sulfate and

¹ The Examiner had pointed to the reference titled, "*Redox Properties of Hydroxylamines, Part 1, Inorganic Reactions*" submitted by Applicants in a previous IDS for a disclosure of the different redox properties of hydroxylamine and its salts. Applicants have reviewed the reference and note that this reference discusses redox properties of hydroxylamine on inorganic compounds but that this reference does not discuss the redox properties of any hydroxylamine salts.

nitrate salts as described in the patent literature indicate that hydroxylamine salt is a derivative of hydroxylamine and is not the same chemical entity as free hydroxylamine.

Further, Applicants submit that hydroxylamine and hydroxylamine salts such as the sulfate salt have different physical properties. For example, hydroxylamine has a melting point of 33 °C, whereas the hydroxylamine chloride and sulfate salts have a much higher melting point of 151 °C and 170 °C respectively. *See*, The Merck Index at 7459, (attached herewith in the supplemental IDS).

Moreover, Applicants submit that the chemical mechanical polishing (CMP) chemistries of hydroxylamine and that of the hydroxylamine salts (nitrates and sulfates) are not the same because of their differing oxidation potentials. In fact, the CMP results show that the polishing rates using hydroxylamine nitrate is the reverse of the expected pH effect based on Pourbaix diagram. *See* instant published application, p.7 at paragraph [0106]. For example, the specification states:

Recent experiments with 10% hydroxylamine nitrate in DI water showed that 3000 Å copper metal on a 300 Å Ti metal layer could be cleanly removed; @ pH 3 about 100 Å/min, pH 4 about 125 Å/min and pH 5 about 1000 Å/min. This is exactly the reverse of the expected pH effect from the Pourbaix diagram and is the result of the oxidation potential. *See* specification, p. 7, paragraph [0106].

When the free base hydroxylamine (5% in DI water) was tested with the same type of copper wafer, the etching rate dropped to 75 Å/min compared to a 10% ammonium hydroxide with a 100 Å/min rate. *See* Specification, p. 7, paragraph [0107].

Applicants submit that the foregoing passage in the specification shows that hydroxylamine salts, *i.e.*, hydroxylamine nitrate and sulfate, do not display the same redox chemistries during polishing depending upon the pH of the slurry. Accordingly, in view of the chemical distinctions of hydroxylamine and hydroxylamine derivatives (excluding hydroxylamine) such as the hydroxylamine nitrate and sulfate salts, the independent claims 14

and 27 as amended are believed to be unobvious and allowable over Tsai because Tsai teaches hydroxylamine not hydroxylamine derivative (excluding hydroxylamine) in his composition.

For all the foregoing reasons, Applicants request withdrawal of this rejection as to amended claims 14 and 27 and as to the corresponding dependent claims 2-10 and 16-26 that depend from independent claim 14.

E. New Claims 28-33

New dependent claims 28-33 have been added by this Amendment that depend from independent claims 14 and 27. Tsai and Sun cited above, alone or in combination, fails to teach or suggest all the limitations of these claims. New dependent claims 28-33 further recite wherein hydroxylamine derivative is hydroxylamine nitrate, hydroxylamine sulfate and mixtures thereof. In view of these distinctions of hydroxylamine derivatives and hydroxylamine, Applicants submit that all the pending claims are in condition for allowance.

F. Request for Allowance

In view of the amendments and arguments presented above, all pending claims are now believed to be in condition for allowance, an indication of which is solicited. In the event that any issues remain outstanding, Applicants would appreciate the courtesy of a telephone call to the undersigned counsel to resolve such issues in an expeditious manner so as to place this application in condition for allowance.

No additional fees are believed due, other than the separately filed two-month extension fee. However, if any additional fees are determined to be due, the Commissioner is hereby authorized to charge these fees to the Morgan, Lewis & Bockius deposit account no. 50-0310.

Respectfully submitted,

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